

Mobile Digital Television (MDTV)

The coming handheld revolution



screen Digest

Mobile Digital Television: The coming handheld revolution

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5 Different requirements for fixed portable and mobile reception

Introduction

There are very different requirements for digital terrestrial television systems offering services to fixed, portable, or mobile antennas. Rooftop antennas are associated with fixed reception, portable reception is usually fixed indoor reception with an indoor antenna (although it can also be outdoors), and mobile reception is reception in a moving vehicle at a given speed. (Portable is a special case of mobile, as it is usually indoors, and the speed of the antenna is zero.)

The reception mode has major implications for the topology of the transmission network to provide the desired reception mode and for the complexity of the receiver. As mentioned earlier, the ATSC digital terrestrial television system cannot support mobile television service because it is unable to cope with signal paths that are rapidly varying with speed. Only recently have prototype receivers been implemented for that system which provide good quality indoor reception. The discussion in this chapter centres on COFDM digital television systems such as DVB-T and ISDB-T. In Chapter 12 we discuss the key features of DVB-H, an optimised derivative of DVB-T for handheld mobile television.

Fixed reception mode

The fixed reception mode is the easiest reception mode for digital, or indeed, analogue terrestrial television systems. In this case the antenna is usually outdoors on the rooftop and may be a large directional

antenna with suitable gain pointed towards the transmitting station.

In the coverage planning methods which are used, it is usually assumed the antenna is mounted 10m above ground level, has a gain of 10dB, and losses due to the attenuation of the signal running down the feeder cable are 3dB. The radiofrequency channel conditions are assumed to be Gaussian: that is fairly simple reception conditions without too many reflections, which can be overcome by the directional rooftop antenna. In this case the system performance is measured by its Carrier/Noise (C/N) threshold, that is the minimum signal to noise ratio measured in dB, for the signal to be successfully decoded by the receiver. The C/N number in this case is the AWGN (Average White Gaussian Noise) measurement.

Portable reception mode (indoor)

The portable reception mode is a more difficult mode for digital, or indeed, analogue terrestrial systems. In this case the antenna is usually indoors, may have poor directionality properties, may have low gain, and there may be very significant attenuation of the incoming signal due to building, reflection and height losses as the antenna may be located at ground level. In the coverage planning methods that are used, it is usually assumed the antenna is mounted 1.5m above ground level, has a gain of 1.5dB, and losses due to height and building attenuation can be as high as 17dB.

The radiofrequency conditions associated with portable reception are referred to as Ricean, complex reception conditions with multiple signal paths and with people walking about near the antenna changing the reception paths. In this case, the ability of the DTT system to manage multiple echos and changing signal paths in the receiver implementation is critical: the two COFDM systems manage this very effectively. As in the fixed reception mode the system performance is measured by its Carrier/Noise threshold for the Ricean (portable) channel: that is the minimum Carrier/Noise ratio measured in dB for the Ricean channel for which the system delivers error-free video.

Portable reception mode (outdoor)

In outdoor portable and mobile reception modes it is assumed that the antenna is located 1.5m above the ground, is omnidirectional, has very low gain, and will have significant height losses compared to rooftop reception. If the receiver moves, reception depends on the speed of the receiver, the nature of the signal paths (which will be many due to reflections), and the number of signal reflections. The channel profile for outdoor portable reception is the Rayleigh channel profile characterised by non-line of sight paths between the receiver and the transmitter and multiple signal echos.

For mobile reception performance it is more appropriate to consider channel profiles, which more accurately model reception conditions of mobile wireless communications systems. These channel profiles are based on those used in cellular communications systems and discussed in the next chapter. In general receivers which are able to provide mobile television services must be able to handle very high speeds, handle very strong reflections, and fast fading reception conditions.

We discuss the case of mobile reception performance in the chapters that follow in more detail, as this has a material bearing on the economics of deployment.

Coverage definitions

A location (small defined area e.g. 100m x 100m) is said to be covered by a transmitter if the required carrier to noise and carrier to interference values for the system are achieved for 99 per cent of the time. Wide area coverage is then defined to be the sum of the coverage blocks.

In digital television systems 'good' coverage is defined as 95 per cent of receiving locations being covered and 'acceptable' coverage is defined to be 70 per cent of locations served.

Note that mobile systems may require 99 per cent of locations to be served within the designated coverage area.

This can have major implications for the network topology of a mobile television service and the receiver technology, which will be discussed later.

Illustrative examples

The tables that follow show the differences between the various reception modes and analogue television in required signal strengths for 70 per cent locations, 90 per cent locations and for a mobile television service (with and without diversity reception enhancements.) Purely for illustrative purposes, the results are depicted for the PAL analogue television system and for various transmission modes of the DVB-T COFDM system. The results are striking as they have major implications for the commercial rollout of portable and mobile digital television services.

Figure 4 shows that, as expected, higher field strengths are needed for portable indoor

Figure 4: Fixed reception modes comparison (min. median field strengths needed)

television band	VHF III	UHF IV	UHF V
Fixed outdoor reception signal strengths (dBuV/m)			
analogue TV	55	65	70
DVB-T(64QAM, FEC 2/3, GI 1/32 mode, Ricean channel)			
70% locations	39	44	48
95% locations	45	50	54
Portable outdoor reception signal strengths (dBuVm)			
analogue TV	55	65	70
DVB-T (same mode, Rayleigh channel)			
70% locations	59	65	69
95% locations	64	71	75
PORTABLE INDOOR RECEPTION SIGNAL STRENGTHS (dBuV/m)			
Analogue TV	55	65	70
DVB-T(same mode, Ricean channel)			
70% locations	66	73	77
95% locations	73	83	87

Source: DVB, EBU, and various vendor measurements



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